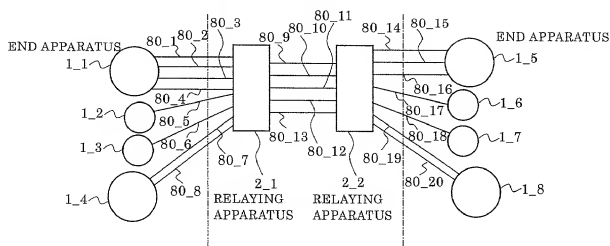FIG.1 A GENERAL NETWORK ARRANGEMENT



FIG.1 B SPECIFIC NETWORK ARRANGEMENT
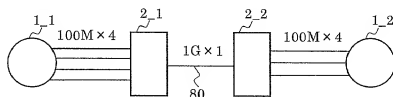


FIG.1 C LINK AGGREGATION & SUB-LOGICAL LINK
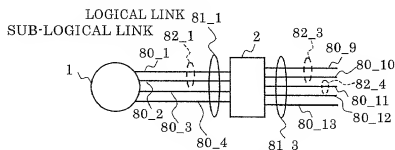


FIG.1 D OPERATION EXAMPLE OF SUB-LOGICAL LINKS

# FIG.2



20 DISTRIBUTOR

TRAFFIC 83

84a IDENTIFYING INFORMATION

22 IDENTIFYING DATA TABLE

84

21 OBJECT IDENTIFYING PORTION

NON-OBJECT TRAFFIC 83b

26 TRAFFIC MONITOR

OBJECT TRAFFIC 83a

MONITORING INTERVAL SETTING VALUE 85

27 MONITORING TIMER

VALUE SETTING BY AGGREGATION CONTROLLER 40 OR MANAGEMENT TOOL

86

MONITORING TIMING SIGNAL 85a

90 MANAGER

25 NON-OBJECT ASSIGNMENT PORTION

87

24 OBJECT ASSIGNMENT PORTION

23

88

83b_2

83b_1

83a_3

83a_2

83a_1

PORT  PORT  PORT  PORT  PORT

10_5  10_4  10_3  10_2  10_1

81_3

82_4  82_3

80_13  80_12  80_11  80_10  80_9

## FIG.3A  IDENTIFICATION BASED ON MAC ADDRESS

22

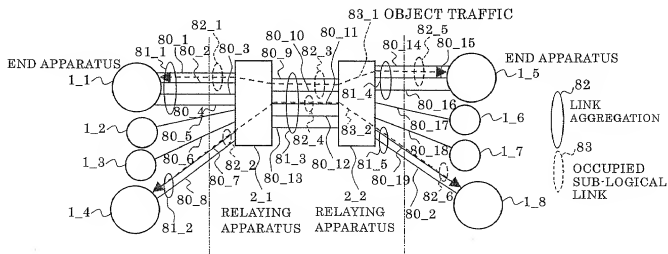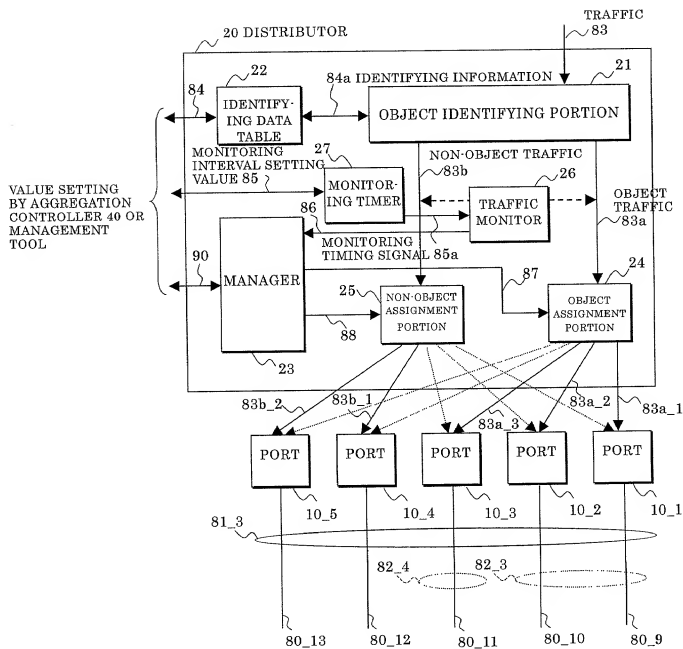| KIND OF IDENTIFYING INFORMATION (IDENTIFYING CONDITION) | VALUE OF IDENTIFYING INFORMATION (CONDITION VALUE) |
|---|---|
| SOURCE MAC ADDRESS | 00:00:0e:14:32:22 |
| DESTINATION MAC ADDRESS | 00:e0:5f:53:22:21 |
| ⋮ | ⋮ |

## FIG.3B  IDENTIFICATION USING INFORMATION OF IP/TCP HEADER

22

| KIND OF IDENTIFYING INFORMATION (IDENTIFYING CONDITION) | VALUE OF IDENTIFYING INFORMATION (CONDITION VALUE) |
|---|---|
| SOURCE IP ADDRESS | 133.10.15.3 |
| DESTINATION IP ADDRESS | 124.10.5.38 |
| DESTINATION PORT NO. | 69 |
| ⋮ | ⋮ |

## FIG.3C  IDENTIFICATION CORRESPONDING TO SUB-LOGICAL LINKS

22

| KIND OF IDENTIFYING INFORMATION (IDENTIFYING CONDITION) | VALUE OF IDENTIFYING INFORMATION (CONDITION VALUE) (SUB-LOGICAL LINK 82_3) | VALUE OF IDENTIFYING INFORMATION (CONDITION VALUE) (SUB-LOGICAL LINK 82_4) | ... |
|---|---|---|---|
| SOURCE MAC ADDRESS | 00:00:0e:14:32:22 | — | ... |
| DESTINATION MAC ADDRESS | 00:e0:5f:53:22:21 | — | ... |
| SOURCE IP ADDRESS | — | 12.35.120.25 | ... |
| DESTINATION IP ADDRESS | — | 122.131.11.221 | ... |
| PORT NO. | — | 69 | ... |
| ⋮ | ⋮ | ⋮ | ... |

# FIG.4

23 MANAGER

VALUE SETTING
BY AGGREGATION
CONTROLLER 40 OR
MANAGEMENT TOOL

90a

71 THRESHOLD VALUE TABLE

95

72 DISCRIMINATING PORTION

86

FROM TRAFFIC MONITOR 26

90b

MONITORING TIME TABLE

73

74

92

91

COUNTER

96

93

75 NUMBER CHANGING PORTION

94 NUMBER INCREASING/DECREASING INSTRUCTION SIGNAL

90c

76 PORT MANAGER

77 PORT MANAGING TABLE

87 UPDATE INFORMATION

TO OBJECT ASSIGNMENT PORTION 24

88 UPDATE INFORMATION

TO NON-OBJECT ASSIGNMENT POTION 25

## FIG.5A

THRESHOLD VALUE TABLE 71

| OCCUPATION NUMBER | TRAFFIC AMOUNT | PORT AVAILABLE RATE FOR OBJECT TRAFFIC | PORT AVAILABLE RATE FOR NON-OBJECT TRAFFIC |
|---|---|---|---|
| 1 | 80Mbps | | |
| 2 | 160Mbps | | |
| 3 | 240Mbps | 80% | 80% |
| 4 | 320Mbps | | |
| ⋮ | ⋮ | | |

## FIG.5B

MONITORING TIME TABLE 73

| CORRESPONDING COUNTER | COUNT |
|---|---|
| RELEASING COUNTER | 50 TIMES |
| DECREASING COUNTER | 50 TIMES |

## FIG.5C

PORT MANAGING TABLE 77

| PORT | FOR OBJECT TRAFFIC |
|---|---|
| 10_1 | ○ |
| 10_2 | ○ |
| 10_3 | ○(□→○) |
| 10_4 | □ |
| 10_5 | □ |

○：OCCUPIED PORT(PORT FOR OBJECT TRAFFIC)

□：NON-OCCUPIED PORT(PORT FOR NON-OBJECT TRAFFIC)

# FIG.6

```
                    ┌──────────────┐
                    │   TRAFFIC    │～26
                    │   MONITOR    │
                    └──────┬───────┘
                          ～86    72(23)
                    ┌──────┴───────┐
                    │CONFIRMATION OF│
                    │  CONDITION BY │～S10
                    │DISCRIMINATING PORTION│
                    │   (MANAGER)   │
                    └──────┬───────┘
```

S11

DISCRIMINATION OF OBJECT TRAFFIC

| (4)OCCUPATION RELEASING LEVEL | (3)NUMBER DECREASING LEVEL | (2)NUMBER INCREASING LEVEL | (1)USUAL LEVEL |
|---|---|---|---|

```
     S16
┌──────────────┐    ┌──────────────┐ S19   ┌──────────────┐
│  INCREMENT   │    │  INCREMENT   │       │ RESET ALL    │ S12
│  RELEASING   │    │  DECREASING  │       │ COUNTERS     │
│ COUNTER (+1) │    │ COUNTER (+1) &│      └──────────────┘
└──────┬───────┘    │RESET RELEASING│
       S17          │   COUNTER    │
   ◇────────◇       └──────┬───────┘
  ╱   PRE    ╲  NO
 ◇ DETERMINED  ◇────────────
  ╲MONITORING COUNT╱        │
   ╲IS EXCEEDED?╱      ◇────┴────◇  S20
    ◇───┬───◇        ╱    PRE    ╲  NO
       YES         ◇ DETERMINED   ◇──────────────
                    ╲MONITORING COUNT╱           │
┌──────────────┐ S18 ╲IS EXCEEDED?╱              │
│   RELEASE    │      ◇────┬───◇      ┌──────────┴───┐ S14  ┌──────────────┐ S13
│  OCCUPATION  │          YES    S21  │   INCREASE   │      │  MAINTAIN    │
└──────┬───────┘       ┌───────────┐  │    NUMBER    │      │   NUMBER     │
       │               │  DECREASE │  └──────┬───────┘      └──────┬───────┘
       │               │   NUMBER  │         │                    │
       │               └─────┬─────┘         │                    │
       └─────────────────────┼──◄────────────┴────────────────────┘
                      ┌───────┴──────┐ S15
                      │  RESET ALL   │
                      │  COUNTERS    │
                      └──────────────┘
```

# FIG.7

- 40
- AGGREGATION
- 40a CONTROLLER
- 40b EXTENDED AGGREGATION CONTROLLER
- 41
- 42

PRIOR ART PROCESS

SHARED INFORMATION TABLE

MESSAGE GENERATOR

PROCESSOR

46

TIMER

43 MESSAGE DISCRIMINATING PORTION

44

45 MESSAGE CONTROLLER

TO OTHER AGGREGATION CONTROLLER OR UPPER LAYER

84,85,90(90a~90b)

TO DISTRIBUTOR 20

98

TO SCHEDULER 60

TO EACH PORT 10

# FIG.8

41

| | SUB-LOGICAL LINK 82_3 | SUB-LOGICAL LINK 82_4 | ... |
|---|---|---|---|
| OCCUPATION FLAG | on | on | ... |
| REQUEST NUMBER | 2 | 1 | ... |
| REQUEST BAND PER SINGLE LINK | 100 (Mbps) | 100 (Mbps) | ... |
| REQUEST SOURCE ADDRESS | 00:00:0e:14:32:22 | 00:00:0e:14:32:29 | ... |
| DESTINATION ADDRESS | 00:e0:5f:53:22:21 | 00:e0:5f:53:22:26 | ... |
| IDENTIFYING CONDITION 1 | SOURCE MAC ADDRESS | SOURCE IP ADDRESS | ... |
| CONDITION VALUE 1 | 00:00:0e:14:32:22 | 12.35.120.25 | ... |
| IDENTIFYING CONDITION 2 | DESTINATION MAC ADDRESS | DESTINATION IP ADDRESS | ... |
| CONDITION VALUE 2 | 00:e0:5f:53:22:21 | 122.131.11.221 | ... |
| IDENTIFYING CONDITION 3 | NONE | DESTINATION PORT NO. | ... |
| CONDITION VALUE 3 | — | 69 | ... |
| IDENTIFYING CONDITION 4 | — | NONE | ... |
| CONDITION VALUE 4 | — | — | ... |
| ⋮ | ⋮ | ⋮ | ... |

# FIG.9

OCTET

| | |
|---|---|
| SAME AS PRIOR ART LINK AGGREGATION BEFORE "RESERVED" | 74 |
| FOR PRESENT INVENTION | 32 |
| RESERVED | 18 |
| FRAME CHECK SEQUENCE (FCS) | 4 |

OCTET

| | |
|---|---|
| TLV_type=Extend_Distribution | 1 |
| Extend_Distribution_Length=32 | 1 |
| Message_Type | 1 |
| Request_System_Address | 6 |
| Target_System_Address | 6 |
| Request_band | 1 |
| Information COMPOSED OF "IDENTIFYING CONDITION" & "CONDITION VALUE" | 16 |

0         7

BAND PER SINGLE LINK    REQUEST NUMBER 1~31

Message_Type
  01 : REQUEST
  02 : RESPONSE
  03 : REJECTION
  04 : ERROR (NUMBER)
  05 : ERROR (OCCUPIED)
  06 : REQUEST FROM RELAYING APPARATUS
  07 : RELEASE REQUEST
  8X : MESSAGE IN A SINGLE LINK
      (X : 1~7)

001 : 10Mbps
010 : 100Mbps
011 : 1Gbps
100 : 10Gbps

# FIG.10A USUAL SEQUENCE



| 1_1 | 2_1 | 2_2 | 1_5 |
| REQUEST SIDE END APPARATUS TRANSMIT (RECEIVE) | RELAYING APPARATUS RECEIVE TRANSMIT (TRANSMIT RECEIVE) | RELAYING APPARATUS RECEIVE TRANSMIT (TRANSMIT RECEIVE) | RESPONSE SIDE END APPARATUS RECEIVE (TRANSMIT) |

REQUEST OCCUPATION NUMBER

① REQUEST OCCUPATION NUMBER ②

REQUEST OCCUPATION NUMBER ②

REQUEST RETURN OCCUPATION LINK ②

REQUEST RETURN OCCUPATION LINK ②'

REQUEST RETURN OCCUPATION LINK ③

ERROR (NUMBER) ②"

RESPOND COMPLETION OF SECURING ③'

ERROR (NUMBER)

RESPOND COMPLETION OF SECURING

RESPOND COMPLETION OF SECURING ③"

REJECT OCCUPATION

REJECT OCCUPATION

REJECT OCCUPATION

REQUEST RETURN OCCUPATION LINK ④ REQUEST MESSAGE FOR NOT SECURING NUMBER

REQUEST OCCUPATION RELEASE ⑤

REQUEST OCCUPATION RELEASE

REQUEST OCCUPATION RELEASE

ERROR (NUMBER) ⑥

⑥

ERROR (NUMBER)

# FIG.10B SEQUENCE UPON REQUEST OVERLAPPED



| 1_4 | 2_1 | 2_2 | 1_5 |
| REQUEST SIDE END APPARATUS TRANSMIT (RECEIVE) | RELAYING APPARATUS RECEIVE TRANSMIT (TRANSMIT RECEIVE) | RELAYING APPARATUS RECEIVE TRANSMIT (TRANSMIT RECEIVE) | RESPONSE SIDE END APPARATUS RECEIVE (TRANSMIT) |

REQUEST OCCUPATION NUMBER

S1 REQUEST OCCUPATION NUMBER ⑦

⑦ S2

S3 ⑦"

ERROR (OCCUPIED)

STANDBY FOR A CERTAIN PERIOD

REQUEST OCCUPATION NUMBER

S4 REQUEST OCCUPATION NUMBER

REQUEST OCCUPATION NUMBER

RESPOND COMPLETION OF SECURING

RESPOND COMPLETION OF SECURING

RESPOND COMPLETION OF SECURING

# FIG.11

1_1 OR 2_1

1_2 OR 2_2

| MAC CLIENT | 50 | 100 |

100

50

| MAC CLIENT | 50 | 100 |

40

30

20

| AGGREGATION CONTROLLER | COLLEC-TOR | DISTRIBU-TOR |

20

30

40

| DISTRIBU-TOR | COLLEC-TOR | AGGREGATION CONTROLLER |

| PORT | 10a_1

10a_1 | PORT |

60

SCHEDULER

60

SCHEDULER

| PORT | 10a_2

10a_2 | PORT |

PREFERENTIAL PROCESS OF OBJECT TRAFFIC BY SCHEDULER

# FIG.12



TRAFFIC
83

20 DISTRIBUTOR

84  22  84a  21

IDENTIFY-
ING DATA
TABLE

OBJECT IDENTIFYING PORTION

27

85  MONITOR-
ING TIMER  83b  26

86  TRAFFIC
MONITOR  83a

85a

90  24

MANAGER  25  87

NON-OBJECT
ASSIGNMENT
PORTION

OBJECT
ASSIGNMENT
PORTION

88

23

SCHEDULE MANAGEMENT SIGNAL 98
(INSTRUCTIONS FROM PROCESSOR 44)

83b  83a

PORT  10a_1

60

SCHEDULER

PREFERENTIAL PROCESS OF
OBJECT TRAFFIC BY SCHEDULER

PORT  10a_2

80

PRIOR ART

## FIG.13A

OUTLINE OF LINK AGGREGATION



END APPARATUS
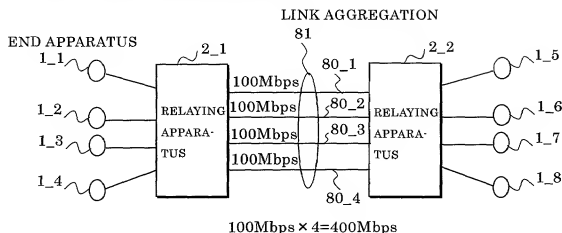LINK AGGREGATION
81

100Mbps × 4=400Mbps

## FIG.13B

OUTLINE OF LINK AGGREGATION PORT FUNCTION



INFORMATION HELD BY PORT

·INFORMATION ON PARTNER PORT
  SYSTEM ID : A
  LINK AGGREGATION GROUP ID : a
  PORT ID : 1
·INFORMATION ON ACTOR PORT
  SYSTEM ID : B
  LINK AGGREGATION GROUP ID : b
  PORT ID : 1

※INFORMATION ON PRIORITY
  BESIDES ID

## FIG.14A



1_1 END APPARATUS   2_1   RELAYING APPARATUS   2_2   1_5

| MAC CLIENT ~50 | MAC CLIENT ~50 | MAC CLIENT ~50 | MAC CLIENT ~50 |

BAND CONTROL DEVICE 100

BAND CONTROL DEVICE 100a   BAND CONTROL DEVICE 100b

BAND CONTROL DEVICE 100b   BAND CONTROL DEVICE 100a

BAND CONTROL DEVICE 100

PORT ~10

PORT ~10a   PORT ~10b

PORT ~10b   PORT ~10a

PORT ~10

80a        80b        80a

## FIG.14B



1 (2)

50 ~ MAC CLIENT

~97   ~83

40 AGGREGATION CONTROLLER

30 ~ COLLECTOR

20 ~ DISTRIBU-TOR

~100

10b

PORT   PORT   PORT   PORT

10_1   10_2   10_3   10_4

# FIG.15

| Field | Octets |
|---|---|
| **MAC Header** | |
| Destination Address | 6 |
| Source Address | 6 |
| Length/Type | 2 |
| Subtype = LACP | 1 |
| Version Number | 1 |
| **TLV Actor_Information** | |
| TLV_type = Actor Information | 1 |
| Actor_Information_Length=20 | 1 |
| Actor_System_Priority | 2 |
| Actor_System | 6 |
| Actor_Key | 2 |
| Actor_Port_Prioirty | 2 |
| Actor_Port | 2 |
| Actor_State | 1 |
| Reserved | 3 |
| **TLV (Partner_Information)** | |
| TLV_type = Partner Information | 1 |
| Partner_Information_Length=20 | 1 |
| Partner_System_Priority | 2 |
| Partner_System | 6 |
| Partner_Key | 2 |
| Partner_Port_Priority | 2 |
| Partner_Port | 2 |
| Partner_State | 1 |
| Reserved | 3 |
| **TLV Max Delay Time Information** | |
| TLV_type = Collector Information | 1 |
| Collector_Information_Length=16 | 1 |
| Collector Max Delay | 2 |
| Reserved | 12 |
| **TLV Terminating Information** | |
| TLV_type = Termintor | 1 |
| Terminator_Length = 0 | 1 |
| Reserved | 50 |
| FCS | 4 |

Actor_Information = 20
Partner_Information = 20
Collector Information = 16
74
128

OCTET TRANSMISSION (TOP TO BOTTOM)

b0 ———————————————————— b7

BIT TRANSMISSION (LEFT TO RIGHT)